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Practice device artificial improvement basis of soil technologies jet grouting

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Abstract

To ensure the mechanical safety "base + foundation + building" system can control all its components. One of these techniques is to design the control device and artificially improved grounds with the required mechanical properties. This problem is perspective in those cases where the base building condition is very poor, and the payment of their impact modification of other components of the system is impractical or economically inefficient. This approach has been implemented by "New Ground" on more than 300 construction sites in the Perm region, Moscow, St. Petersburg, Krasnodar, Samara, Ufa, Tyumen, Kazan. Geotechnical monitoring of construction projects carried out jointly with specialists of the Perm National Research Polytechnic University, Institute of Continuum Mechanics and Mining Institute (Ural Branch of the Russian Academy of Sciences). Practical experience in this kind of artificial bases proposed for discussion in the framework of the proposed report.

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1. Introduction

Jet technology, known as «Jet-grouting method», is an advanced research field in modern geotechnick. Application of jet grouting enables to create homogeneous foundation soil with the pre-set physical and mechanical properties, and it provides a high serviceability [1]. Furthermore, in comparison with traditional design

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considerations, for example, application of bored piles, operation time and base preparation cost decrease. The construction method of jet grouting makes it possible to control compression zones of a base and modify its properties at best depth range [8,9]. To ensure the mechanical safety "base + foundation + building" system can control all its components. One of these techniques is to design the control device and artificially improved grounds with the required mechanical properties. This problem is perspective in those cases where the base building condition is very poor, and the payment of their impact modification of other components of the system is impractical or economically inefficient.

By implementing components of low construction condition of the system include: inconsistency lithological soil layers; pronounced heterogeneity of the soil structure within a single genetic layer; the possibility of moving the soil in a structurally unstable state; low strength and deformation characteristics of soil, certainly not to ensure reliable operation of the system. Such condition bases can be achieved throughout the system's life cycle: identified during the design and survey work; predicted by the analysis of possible changes in the geotechnical situation in the period of operation; recorded in the course of operation (more often on the characteristic features of the system behavior).

One of the possible ways to create artificially enhanced base unit is "structural geomassiv" with projected effective mechanical characteristics. The principle of this device is to perform geomassiv vertical reinforcing subgrade rigid elements, performed by jet grouting soil surface technology and creating a flexible distribution layer. Methods of designing "structural geomassiv" are described in several publications and give a base with high building condition and perform the field control predetermined characteristics.

2. Monitoring of formation conditions of the hard element

One of the examples is the construction of a new stadium of the football club «Krasnodar», the site of which is situated in the city of Kransodar, in Prikubansky interurban district. The terrain of the construction site is relatively flat. The absolute marks of the ground surface range from 27,2 till 28,4m.

Within the limits of the soil column, studied during soil investigation (to the depth of 40m), 7 engineering geological elements were separated: EGE-1 hard loam, collapsing (E=12.4MPa); EGE-2 semisolid loam (E=16.5MPa); EGE-3 silty sand, tight (E=28MPa); EGE-4 semisolid clay (E=14.9MPa); EGE-5 stiff loam (E=12MPa); EGE-6 medium sand, tight (E=34MPa); EGE-7 gravel sand, tight (E=41MPa).

The seismic activity at the construction site according to the map OCP-97B in terms of soil conditions is 8 points.

The analysis of engineering and geological conditions of the site with regard to its seismic activity showed that the main problems of the site are the possibility of vibroliquefaction and vibrocreep of the layer of tight silty sands EGE 3, and high porosity of the layer of brown clays EGE-4 at the earthquake intensity of 8 points [2,7].

At the stage of analyzing the stadium building-up documentation the following main peculiarities of its structural layout were found: the essential nonuniformity of loads on foundation and that the tolerances of settlement between the blocks of the stadium must be not more than 2.5cm.

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Therefore, the necessity of foundation grouting is determined by the objective to achieve stiff characteristics of the foundation, which comply with the requirements, imposed to the construction design of the stadium with regard to Relative differential settlement, and potential possibility of vibroliquefaction and vibrocreep of the layers EGE-3 and EGE-4.

Comparing two variants of securing serviceability of the foundation plate base under seismic forces: 1) installation of pile foundation consisting of bored elements, with the length of 15…20 meter and 2) solidification of layers EGE-3 (water-saturated sands) and EGE-4 (semisolid clays) by jet grouting, the second variant was chosen due to the cost and operation time criteria.

Measures for decreasing deformations of foundations and their influence on structures are regulated by the normative requirements. They specify that the design of soil solidification should make provision for the test and production work, moreover slurry compositions for soil solidification by injection method and physical and mechanical properties of soils should be specified according to the results of their solidification in laboratory or field conditions.